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ORIGINAL RESEARCH

Associations Between Transgender Identity, Sleep, Mental Health and Suicidality Among a North American Cohort of College Students

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Shelley Hershner[1]
Erica Jansen[2]
Ronald Gavidia[1]
Lisa Matlen[3]
Mary Hoban[4]
Galit Levi Dunietz[1]

[1]Sleep Disorders Center, Department of Neurology, University of Michigan, Ann Arbor, MI, USA; [2]Department of Nutritional Sciences, University of Michigan School of Public Health, Ann Arbor, MI, USA; [3]Department of Pediatrics; Sleep Disorder Center, University of Michigan, Ann Arbor, MI, USA; [4]American College Health Association, Research Office, Silver Spring, MD, USA

Purpose: The purpose of this study is to examine the associations between transgender identity, sleep, and mental health among a North American cohort of cisgender and transgender college students.

Participants and Methods: This cross-sectional study surveyed 221,549 North American college students from the 2016–2017 American College Health Association-National College Health Assessment II. Bivariate and multivariable analysis examined associations among transgender identity and outcomes of insomnia symptoms, daytime sleepiness, sleep disorder diagnoses and treatments. Mental health outcomes included mood symptoms, suicidal behaviors, anxiety and depression diagnoses and treatments.

Results: Transgender identity was reported by 1.6% (n=3471) of United States (US) and 1.7% (n=717) Canadian students, respectively. Mean age was 22.5 ±6. Transgender college students have an increased prevalence of daytime sleepiness, insomnia symptoms, diagnoses and/or treatment of insomnia and other sleep disorders as compared to cisgender college students. Mental Health symptoms are more prevalent with a 2-fold increase in depression and anxiety and nearly a 4-fold increase in suicide attempts among transgender students. A higher burden of mood symptoms exists among transgender college students in the US in comparison to Canadian students.

Conclusion: Transgender college students have an alarmingly high rate of mood, sleep disturbances and sleep diagnoses, and suicidality. Colleges and universities must provide sufficient resources to address the sleep and mental health needs of transgender students. Institutions must adopt gender affirming policies that promote an inclusive environment. Increased allocation of resources and adoption of policies that enhance the physical and mental health of transgender students could improve sleep, mood, and potentially lower the suicide risk among a population that often experiences health inequities.

Keywords: transgender, college student, sleep, insomnia, mood, suicide

Plain Language Summary

The college years can be a time of growth and opportunity for students, but despite these positive aspects, many college students struggle with mental health and sleep behaviors and daytime symptoms of tiredness and sleepiness. Transgender individuals are a population that face numerous challenges as many struggle with discrimination, isolation, and poor social support. Little research is available on the mental health and sleep of transgender college students. This study evaluated data from the American College Health Association-National College Health Assessment II (ACHA-NCHA II) survey from the United States of America (2016 and 2017) and Canada (2016). The ACHA-NCHA II is a voluntary, confidential survey

Correspondence: Shelley Hershner
Sleep Disorders Center, Department of Neurology, University of Michigan, 728 Med Inn 1500 East Medical Center Drive, Ann Arbor, MI, USA
Tel +1 734-936-6295
Fax +1 734-936-5377
Email shershnr@umich.edu

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that collects information on college students' self-reported health, health behaviors and perceptions. Our study reviewed students' gender identity, sleep, mood, and suicidality. Our results showed: Transgender college students were more likely to have 1) excessive daytime sleepiness, 2) symptoms of insomnia, and 3) a diagnosis of insomnia or other underlying sleep disorder. Mood disturbances are a significant issue as transgender college students were twice as likely to have depression and anxiety and 4 times as likely to have ever attempted suicide. These results suggest that colleges and universities must increase resources to address the mental health and sleep needs of transgender college students. It is vital that this population, which often faces numerous health disparities, experience a gender affirming and supportive college environment.

Introduction

The college years are a time of increased risk for sleep problems, mental health issues, and suicidality.[1–4] Poor sleep among college students can negatively influence academic performance, immunity, risk-taking behaviors, obesity, and cardiometabolic health.[5] Transgender individuals, and likely transgender college students, experience significant mental, physical, and psychologic health disparities for a multitude of reasons which at a minimum include discomfort with one's appearance and identity, limited availability of mental health services, discrimination, and social rejection.[6–8] Due to these risk factors transgender college students could be at a higher risk than cisgender students for sleep disturbances and poor mental health.[9–11]

Transgender and gender diverse identity is used to describe individuals with gender behaviors, appearances, or identities that are incongruent with those culturally assigned to their birth sex.[7,8,12] Gender diverse identities may be referred by many different terms, which include: transgender, non-binary, gender queer, gender fluid, gender creative, gender independent, or non-cisgender.[7] Transgender men were assigned female sex at birth and identify as men, or as female-to-male (FTM). Transgender women were assigned male sex at birth and identify as women, or as male-to-female (MTF). Finally, cisgender refers to a gender identity congruent with the birth sex. As highlighted by the American Academy of Pediatrics policy statement: "These terms are not diagnoses; rather, they are personal and often dynamic ways of describing one's own gender experience." Currently, there is a multitude of terms used in the literature.

Transgender individuals are at risk for sleep disturbances due to a high prevalence of psychosocial stressors, discrimination, poor mood, and hormonal influences.[9,13–15] The college campus does not necessarily provide psychosocial protection as transgender college students experience lower rates of acceptance, belonging, sense of safety, higher rates of discrimination, and exclusion on campus.[9] In a systematic review, interpersonal discrimination is associated with poorer sleep; the underlying mechanisms require further research, but a study among Latino and Asian adolescents found an association with discrimination, perceived stress, and poor sleep.[16,17] Transgender individuals report that hormonal treatment, gender dysphoria, and poor mood adversely impact their sleep.[15] Difficulty with sleep impacts important life domains. Among transgender adults, poor sleep quality negatively affects quality of life.[13] Short sleep in adult transgender individuals is associated with COPD and arthritis for FTM individuals while obesity and stroke risk is increased in multiple categories of transgender individuals.[18] However, few studies have examined sleep among transgender college students.

Sex hormone therapy (SHT) is another risk for poor sleep. Many transgender individuals receive sex hormone therapy (SHT) as a gender affirming treatment for gender dysphoria, a clinical disorder when a transgender individual feels distress and/or incongruence with their assigned gender which interferes with social, school, or other areas of function.[12] Although under-researched in the transgender population, mechanistically, sex hormone therapy can induce sleep disturbances, obstructive sleep apnea, and insomnia in transgender men and women.[13,19,20] Despite some negative effects, sex hormone therapy can benefit mood and quality of life in transgender individuals.[21]

Transgender college students have a 4-fold increase in mental health problems.[22] Mental health disorders which including anxiety, depression, suicidal ideation and attempts are more prevalent among the transgender population than their cisgender peers.[11,22,23] Risk factors for mood issues among transgender college students are a negative cultural environment on campus, poor institutional support, and negative family and community experiences.[24] Consequently, transgender students may feel marginalized even among the lesbian, gay, bisexual and queer (LGBQ) community.[25] In the university health care environment, many transgender students report misgendering by therapists and health providers.[26] In the Transgender Survey, one-third of adults (non-college) participants reported at least one

negative experience related to being transgender within the health care environment.[27] A quarter of participants did not see a doctor due to fear of misgendering or due to transgender-related insurance issues.[27] Despite an increased need for physical and mental health support, transgender students have limited access to transgender competent medical, psychological services.[8,9]

At this time there is minimal research on the comparative experience of transgender college students in Canada and the United States. In 2018, Tyler Clementi Center analyzed 4 national surveys to better understand the experiences of queer-spectrum and trans-spectrum students attending US institutions.[9] Transgender students' experienced poor mental health, discrimination, and often a negative campus environment. It also documented a significant lack of transgender-related resources as less than 15% of American colleges and universities had an employee with at least 20 hours a week dedicated to transgender students. Transgender and gender diverse identity students in Canadian post-secondary institutions also face discrimination and often a negative campus climate.[28] In this sample, 22% of transgender students stated that they had been insulted, mistreated, ignored, or excluded because of their gender as compared to 6% of their peers. However, this study did not separate gender identity but rather investigated perceived gender, gender identity, and sexual orientation. These reports suggest that campus climate is sub-optimal in both countries however, there is no current comparison available.

Overall this data indicates that there is a paucity of research on the sleep, mental health, and suicidality of transgender college students. To fill this gap, the aim of this study was three-fold:

1. Estimate the proportion of transgender students that experience sleep and mental health disturbances, and daytime sleepiness as compared to cisgender college students.
2. Explore the proportion of transgender as compared to cisgender college students who experience mental health and sleep disturbances and daytime sleepiness in the United States as compared to Canada.
3. Establish the prevalence of self-reported suicidal behaviors in a college student transgender population.

We hypothesize that transgender college students would have worse sleep and mental health than cisgender college students. Additionally, we believe that sleep disturbances, poor mental health and suicidal behavior will be more prevalent among US students in comparison to their Canadian peers.

Participants and Methods

Study Design

This was a cross-sectional study of the American College Health Association-National College Health Assessment II (ACHA-NCHA II) survey. Since the data were de-identified at both the institution and student level, approval was granted from the Institutional Review Board from the University of Michigan.

Study Participants

The study population included students from the United States (US) and Canada who attend institutions that enrolled in ACHA-NCHA-II survey. US schools participated during the 2016 and 2017 spring and fall semesters while Canadian schools participated during spring 2016 (Table 1).

Survey

The ACHA-NCHA II is a voluntary, confidential survey that collects information on college students' self-reported health, health behaviors and perceptions. Content includes 66 questions covering the domains of substance use, sexual, mental, and physical health, weight, nutrition, exercise, personal safety, violence, and impediments to academic performance. Individual institutions determine the number of students surveyed and if the survey will be web-based (the majority) or paper-based. Institutions pay to participate in the ACHA-NCHA II with ACHA member institutions receiving a discount. Students are invited to participate in the ACHA-NCHA survey via an e-mail sent by the ACHA or their school with a unique survey link.[29] Non-responders were contacted with up 3 reminder messages. Complete details of survey

Table 1 American College Health Association-National College Health Assessment II Participating Schools and Number of Students

	Schools	Students
Fall 2016	51	33,512
Spring 2016 (US Sample)	137	95,761
Spring 2016 (Canadian Sample)	41	43,780
Fall 2017	52	31,463
Spring 2017	92	63,497

administration are located: https://www.acha.org/NCHA/To_Participate/FAQs/NCHA/To_Participate/FAQ.aspx?hkey=7d4e7ad7-4103-44e2-8980-da5e30c70860.

Survey Validity

The NCHA-ACHA I and II have been repeatedly and systematically evaluated for its validity and reliability.[30] These evaluations have demonstrated strong reliability and validity across survey items.

Survey Questions

Data on sleep and daytime function were collected through 7 questions on sleep, daytime function, and sleep diagnoses (Table 2). Daytime sleepiness was rated on a 5-point scale. The question, "Have you been diagnosed or treated by a professional for a sleep disorder or insomnia?" had dichotomous responses (yes/no). Five items queried about current sleep disturbances while responses to these questions corresponded to the number of symptomatic days in

Table 2 American College Health Association-National College Health Assessment II. Sleep and Mental Health Questions

Measure	Questionnaire Items	Possible Responses	Categorized
Sleep symptoms	**In the past 7 days**: 1. Awakened too early and could not get back to sleep? 2. Felt tired, dragged out, or sleepy during the day? 3. Gone to bed because you just could not stay awake any longer? 4. Had an extremely hard time falling asleep? 5. Did you get enough sleep so that you felt rested when you woke up in the morning?	Days of the week (0–7 days)	≥3 days in a week 0–2 days in a week
	In the past 7 days, how much of a problem have you had with sleepiness?	No problem at all A little problem More than a little problem A big problem A very big problem	Infrequent • No problem at all Sometimes • A little problem • More than a little problem Frequent • Big problem • Very big problem
	Within the last 12 months, have you been diagnosed or treated by a professional for either?	Insomnia Other sleep disorder	Yes/No
Mental health symptoms	**Have you ever?** 1. Felt things were hopeless 2. Felt overwhelmed by all you had to do 3. Felt exhausted (not from physical activity) 4. Felt very lonely 5. Felt very sad 6. Felt so depressed that it was difficult to function 7. Felt overwhelming anxiety 8. Felt overwhelming anger 9. Intentionally cut, burned, or otherwise injured yourself 10. Considered suicide 11. Attempted suicide	No, never No, not in 12 months Yes, in the last 2 weeks Yes, in the last 30 days Yes, in the last 12 weeks	Yes for any positive response (e.g not never)
	Have you ever been diagnosed with depression?	Yes/No	Yes/No
	Within the last 12 months, have you been diagnosed or treated by a professional for either? • Anxiety • Depression		
	Have you received psychological or mental health services from your current college/university's Counseling or Health Service?	Yes/No	Yes/No

a week. This was categorized into 0–2 days versus ≥3 days for analysis as the diagnostic criteria for insomnia requires insomnia symptoms at least 3 days a week. Excessive daytime sleepiness has been defined as significant when experienced often (5–15/month) or almost always (16–30/month) consistent with a weekly frequency of 3 or more days a week.[31,32] Fourteen self-reported mental health-related questions included: "Have you had or felt hopeless, overwhelmed, sad, lonely, depressed, anxious, angry, self-harm, suicidal thoughts, or attempted suicide?" These were classified by frequency. A dichotomous response was used for the question if subjects had been diagnosed or treated by a professional for anxiety, depression, or had received counseling.

Gender Identity

Students identified their gender assigned at birth as well as their current gender.[33] Information on gender identity was collected with three questions: 1. "What sex were you assigned at birth, such as on an original birth certificate," with a response of male or female 2. "Do you identify as transgender?" with a response of yes or no and 3. "Which term do you use to describe your gender identity?" The responses were woman, man, trans man, trans woman, genderqueer and another identity (please specify). Respondents were classified as cisgender male or female if their gender identity was consistent with their gender assigned at birth and responded "no" for transgender identity. Students who reported transgender identity were classified as transgender. If a student did not identify as transgender but had a difference between their assigned sex and gender identity were considered as non-binary.

In the primary analyses only students who self-identified as transgender were included in the initial analysis. In a sensitivity analysis, we included non-binary students or those students who did not identify as transgender, but reported a mismatch between their birth and assigned gender.[33] In the US 328 subjects met that classification and 95 subjects in Canada.

Covariates

Potential confounders were selected a priori using directed acyclic graphs and previous literature. Demographic and college-related variables with an impact on mental health and health behaviors were included in adjusted analysis.[30] Covariates included race/ethnicity, semester, and year in school, college size, Carnegie Classification which groups institutions of higher institutions into comparable degree-granting categories, campus setting (eg-very large city >500,000) and region of the US. Region was not available for Canadian schools.

Statistical Analysis

Descriptive procedures (chi-square tests) were used to examine the distributions of students within sociodemographic categories according to transgender identity (cisgender versus transgender) and separately for the US and Canada.

In bivariate analysis, stratified by country, the proportion of students per each sleep disturbance were calculated for cisgender versus transgender participants. Logistic regression models were used to identify covariates that may confound the associations between transgender identity, sleep, and mood disturbances.

The associations between transgender identity, as the exposure, and sleep mental health as separate outcomes, was estimated with logistic regression models, adjusted for race/ethnicity, semester (the US only), college size, campus setting, Carnegie classification (the US only), region (the US only), and year in school. Formal interaction analysis was performed to examine if the country of origin moderates the association of sleep and mental health parameters among transgender individuals. We added to the regression models transgender identity and country as main effects, an interaction term for country*transgender identity, adjusting for potential confounders.

Finally, in sensitivity analyses, we added to the transgender group students who did not self-identify as transgender, but reported discordance between their assigned birth sex and gender identity. All analyses were performed in SAS v 9.4.

Results

In a cohort of 221,549 college students, 3471 and 717 (1.6% and 1.7%) reported transgender identity in the US and Canada, respectively (Tables 3–5). Non-binary students or those students who did not identify as transgender, but reported a mismatch between their birth and assigned gender consisted of 423 participants (US 328 and Canada 95).

Cisgender students had similar mean age, regional distribution, and college type attendance. Different racial distribution, patterns of campus setting, Carnegie classification, and college size were observed between cisgender and transgender students. The majority of subjects were

Table 3 US Sample: Bivariate Associations Between Transgender Identity, Demographic and College Characteristics in a Sample of 221, 549 College/University Students from the United States

Student Characteristics	N	Cisgender (%) N=218, 078	Transgender (%) N=3471	P value
Age, mean (SD)		22.5 (6.0)	22.5 (6.8)	0.74
Race/ethnicity				
White	134,496	132,358 (61.05)	2138 (61.94)	
African American	10,189	10,031 (4.63)	158 (4.58)	
Hispanic	26,174	25,808 (11.90)	366 (10.60)	
Asian/Pacific Islander	30,398	30,034 (13.85)	364 (10.54)	
American Indian, Alaskan Native or Native Hawaiian	3377	3303 (1.52)	74 (2.14)	
>1 race	9460	9243 (4.26)	217 (6.29)	
Other	6163	6028 (2.78)	135 (3.91)	0.01
Semester				
Spring 2016	94,376	92,691 (42.50)	1685 (48.55)	
Fall 2016	33,176	32,706 (15.00)	470 (13.54)	
Spring 2017	62,798	61,959 (28.41)	839 (24.17)	
Fall 2017	31,199	30,722 (14.09)	477 (13.74)	<0.0001
Region				
Northeast	47,781	46,983 (21.54)	798 (22.99)	
Midwest	45,127	44,404 (20.36)	723 (20.83)	
South	48,258	47,597 (21.83)	661 (19.04)	
West	80,383	79,094 (36.27)	1289 (37.14)	0.21
College size (students)				
<2500	22,617	22,125 (10.15)	492 (14.17)	
2500–4999	21,713	21,348 (9.79)	365 (10.52)	
5000–9999	35,757	35,236 (16.16)	521 (15.01)	
10,000–19,999	51,351	50,556 (23.18)	795 (22.90)	
≥20,000	90,111	88,813 (40.73)	1298 (37.40)	<0.0001
Campus setting				
Very large city (>500,000)	59,348	58,377 (26.77)	971 (27.97)	
Large city (250,000–499,999)	23,269	22,936 (10.52)	333 (9.59)	
Small city (50,000–249,999)	75,983	74,888 (34.34)	1095 (31.55)	
Large town (10,000–49,999)	47,988	47,166 (21.63)	822 (23.68)	
Small town (2500–9,999)	11,940	11,740 (5.38)	200 (5.76)	
Rural community (<2500)	3021	2971 (1.36)	50 (1.44)	<0.0001
College/university type				
2-year	12,312	12,105 (5.55)	207 (5.96)	
≥4 years	209,237	205,973 (94.45)	3264 (94.04)	0.29
Carnegie classification				
Associates colleges	12,312	12,105 (5.55)	207 (5.96)	
Baccalaureate colleges	24,100	23,558 (10.80)	542 (15.62)	
Masters colleges/universities	55,270	54,378 (24.94)	892 (25.70)	
Research institutions	125,111	123,357 (56.57)	1754 (50.53)	
Special focus institutions	731	728 (0.33)	3 (0.09)	
Miscellaneous/not classified	4025	3952 (1.81)	73 (2.10)	<0.0001
Year in school				
1st year undergraduate	50,059	49,257 (22.73)	802 (23.27)	
2nd year undergraduate	41,417	40,747 (18.80)	670 (19.44)	

(*Continued*)

Table 3 (Continued).

Student Characteristics	N	Cisgender (%) N=218, 078	Transgender (%) N=3471	P value
3rd year undergraduate	43,016	42,344 (19.54)	672 (19.50)	
4th year undergraduate	35,342	34,781 (16.05)	561 (16.28)	
5th year or more undergraduate	11,147	10,942 (5.05)	205 (5.95)	
Graduate or professional	37,037	36,547 (16.87)	490 (14.22)	
Not seeking a degree	793	772 (0.36)	21 (0.61)	
Other	1336	1311 (0.60)	25 (0.73)	0.04

Table 4 Canadian Sample: Bivariate Associations Between Transgender Identity, Demographic and College Characteristics in a Sample of 43,340 College/University Students from Canada

Students Characteristics	N	Cisgender (%) N=42, 623	Transgender (%) N=717	P value
Age, mean (SD)		22.96 (5.99)	23.39 (8.16)	0.06
Race/ethnicity				
White	30,437	29,959 (70.81)	478 (67.23)	
African American	1396	1373 (3.25)	23 (3.23)	
Hispanic	884	868 (2.05)	16 (2.25)	
Asian/Pacific Islander	5870	5791 (13.69)	79 (11.11)	
American Indian, Alaskan	1697	1657 (3.92)	40 (5.63)	
Native or Native Hawaiian				
>1 race	1281	1417 (2.94)	35 (4.92)	0.0004
College size (students)				
<2500	592	576 (1.35)	16 (2.23)	
2500–4999	1174	1152 (2.70)	22 (3.07)	
5000–9999	8304	8170 (19.17)	134 (18.69)	
10,000–19,999	10,839	10,663 (25.02)	176 (24.55)	
≥20,000	22,431	22,062 (51.76)	369 (51.46)	0.36
Campus setting				
Very large city (>500,000)	19,533	19,207 (45.06)	326 (45.47)	
Large city (250,000–499,999)	7321	7177 (16.84)	144 (20.08)	
Small city (50,000–249,999)	16,328	16,082 (37.73)	246 (34.31)	
Small town (2500–9999)	158	157 (0.37)	1 (0.14)	0.19
College/university type				
2-year	1271	1253 (2.94)	18 (2.51)	
≥4 years	32,768	32,237 (75.63)	531 (74.06)	
Other	9301	9133 (21.43)	168 (23.43)	0.15
Year in school				
1st year undergraduate	9907	9727 (22.96)	180 (25.25)	
2nd year undergraduate	8807	8677 (20.48)	130 (18.23)	
3rd year undergraduate	8005	7876 (18.59)	129 (18.09)	
4th year undergraduate	6303	6197 (14.62)	106 (14.87)	
5th year or more undergraduate	2851	2795 (6.60)	56 (7.85)	
Graduate or professional	5994	5917 (13.96)	77 (10.80)	
Not seeking a degree	436	421 (0.99)	15 (2.10)	
Other	783	763 (1.80)	20 (2.81)	0.95

Table 5 Transgender Identity Among the US and Canadian College Students

	Trans Woman	Trans Man	Genderqueer	Another Identity (Please Specify)
US	137	338	1310	1951
Canada	35	37	203	365

white, attended a school with a student size between 5000 through ≤20,000+ with a campus setting of small town to large city (population of 10,000 through 249,999). Many institutions appear to have the ability to conduct advanced degree or research as 76.2% transgender students attended school with masters colleges/universities or research institutions.

Country-specific associations between transgender identity and sleep disturbances are presented in Table 6. Transgender students were approximately 30% more likely to indicate inadequate sleep duration to feel rested as compared with their cisgender peers in both countries. Similarly, frequent daytime sleepiness was higher in transgender students in both countries. US transgender students were more likely to wake too early compared to cisgender students; OR 1.36 (95% CI 1.26, 1.48). In both countries, transgender students had about 40% higher odds of feeling tired, dragging and sleepy during the day, and higher odds for difficulty falling asleep. This common insomnia symptom had a slightly stronger association among US students compared to Canadian students (P, interaction=0.08). Odds of insomnia diagnosis or treatment were 2.8-fold and 2.5 fold among US and Canadian transgender students, respectively, in comparison to cisgender students. Similarly, odds of diagnosis or treatment of any sleep disorders were more than twice as high in US or Canadian transgender students compared to cisgender.

Table 7 presents country-specific associations between transgender identity and mental health outcomes. Formal interaction analysis suggests that about half of the associations varied significantly by country. Overall, the burden of poor mental health is significantly higher among transgender vs cisgender students. The odds of a diagnosis or treatment of depression is almost 3-fold and 2.4-fold among transgender students in the US and Canada compared with cisgender students, respectively. Similarly, anxiety diagnosis or treatment odds were 2-fold higher in transgender college students with a stronger association among US students than Canadian. Higher odds of negative feelings such as hopelessness, overwhelmed, exhausted, lonely, sad depressed, anxious, or angry, were also observed in transgender vs cisgender students. Similarly, higher self-harm odds were observed in transgender students in both countries. To illustrate, the odds of committing self-harm, considering suicide or attempting suicide are 3.87 (95% CI 3.56, 4.21), 3.45 (95% 3.19, 3.72) and 4.21 (3.59, 4.94) among US transgender vs cisgender students.

In sensitivity analyses which included a difference in transgender classification (students with a difference between gender assigned at birth and gender identity or subjects that did not identify as transgender), results remained unchanged.

Discussion

This large study of North American college students investigated the associations between transgender identity, sleep, mental health, and suicidality. The prevalence of transgender identity was 4-times higher than the reported transgender prevalence of 0.3–0.5% in the general population.[21] Alarmingly, transgender students had a 2-fold higher odds of insomnia diagnosis, sleep and mood disorders, and a 3–4 fold higher odds of suicidal thoughts and attempts. Associations between transgender identity and sleep were similar in the US versus Canada, while associations between transgender identity and poor mental health were stronger in the US.[21]

This study found that transgender individuals were more likely to have inadequate sleep, daytime sleepiness, insomnia symptoms, and a diagnosis of a sleep disorder. Data on sleep among transgender individuals are limited. In a recent review on sleep among gender minority participants, only 4 of 31 studies included transgender subjects.[34] Poor sleep quality is prevalent in non-college transgender women (79.2%) and transgender men (81.2%).[13] A qualitative study of transgender adults, of which 25% were between the ages of 18–21 years-old, observed high proportions of poor sleep quality. Both mood and gender dysphoria had a negative impact on sleep quality.[15] Short sleep (<5 hours) was also common among transgender adults, estimated as 15% and 13.2% in transgender women and men, respectively and with a higher prevalence among transgender gender non-conforming (35.5%) subjects.[18] The prevalence of sleep disorders is nearly unknown among transgender people. A case series that included only 3 patients found that 2 transgender men developed obstructive sleep apnea after starting sex hormone therapy.[35]

Table 6 Associations Between Transgender Identity and Sleep Disturbances Among College/University Students in US and Canada

	United States		Canada		
	Cisgender	**Transgender**	**Cisgender**	**Transgender**	**P, Interaction**
Inadequate sleep to feel rested					
0–2 days in a week	57.42	50.03	56.11	49.23	
≥3 days in a week	42.58	49.97	43.89	50.77	
OR of inadequate sleep to feel rested[1]	Reference	1.35 (1.26, 1.44)	Reference	1.29 (1.11, 1.49)	
P value	<0.0001		0.0009		0.59
Problem with daytime sleepiness					
Infrequent	56.94	47.06	52.45	42.94	
Sometimes	25.48	29.28	26.04	28.11	
Frequent	17.57	23.66	21.50	28.95	
OR of daytime sleepiness problem Sometimes vs Infrequent	Reference	1.38 (1.27, 1.49)	Reference	1.60 (1.34, 1.92)	
P value	<0.0001		<0.0001		0.92
OR of daytime sleepiness problem Frequent vs Infrequent	Reference	1.61 (1.48, 1.75)	Reference	1.31 (1.09, 1.56)	
P value	<0.0001		0.0039		0.57
Wake up too early					
0–2 days in a week	82.70	77.74	82.18	79.49	
≥3 days in a week	17.30	22.26	17.82	20.51	
OR wake up too early	Reference	1.36 (1.26, 1.48)	Reference	1.15 (0.95, 1.38)	
P value	<0.0001		0.1485		0.09
Tired, dragging, sleepy during the day					
0–2 days in a week	39.17	31.10	36.95	27.71	
≥3 days in a week	60.83	68.90	63.05	72.29	
OR of tired, dragging, sleepy during the day	Reference	1.41 (1.31, 1.51)	Reference	1.45 (1.26, 1.78)	
P value	<0.0001		<0.0001		0.53
Gone to bed because cannot stay awake					
0–2 days in a week	68.89	63.49	68.44	64.56	
≥3 days in a week	31.02	36.51	31.56	35.44	
OR of gone to bed because cannot stay awake	Reference	1.28 (1.19, 1.39)	Reference	1.17 (1.004, 1.39)	
P value	<0.0001		0.0444		0.32
Difficulty falling asleep					
0–2 days in a week	73.34	64.21	68.66	62.22	
≥3 days in a week	26.66	35.79	31.34	37.78	
Difficulty falling asleep	Reference	1.51 (1.41, 1.62)	Reference	1.29 (1.11, 1.51)	
P value	<0.0001		<0.0001		0.08
Insomnia diagnosis/treatment					
Yes	4.87	13.26	5.18	12.69	
OR of insomnia diagnosis/treatment	Reference	2.83 (2.56, 3.14)	Reference	2.47 (1.96, 3.12)	
P value	<0.0001		<0.0001		0.28

(*Continued*)

Table 6 (Continued).

	United States		Canada		
	Cisgender	Transgender	Cisgender	Transgender	P, Interaction
Sleep disorders diagnosis/treatment Yes	2.43	6.01	3.29	7.34	
OR of sleep disorders diagnosis/treatment	Reference	2.45 (2.14, 2.87)	Reference	2.29 (1.71, 3.05)	
P value	<0.0001		<0.0001		0.59

This study showed that transgender college students had a 2–3 fold increased odds of depression and anxiety. Accumulated evidence demonstrates that transgender students have higher rates of depression than cisgender peers.[9,22,23,28,36] Our findings corroborate a recent study among transgender college students that showed a 4-fold increase in at least one mood or mental health problem.[22] Transgender college students had a disturbing prevalence of suicidal thoughts (68%), attempts (38%) and self-harm (65%).[11] A multi-national sample of transgender youth reported suicidal behaviors among 29–48% of participants.[37,38]

Sleep, mood, and suicidality are intricately linked.[21,39–41] Insomnia and depression independently and jointly impact suicide, regardless of gender identity.[39] In cisgender adolescents with insomnia symptoms, a 2-fold increased risk of suicidality is present even without a mental health comorbidity.[42] Depressed cisgender adolescents have a 3–4 fold higher risk of insomnia as compared to non-depressed peers.[43] The severity of depression is strongly associated with suicide and non-fatal suicidal behaviors.[40] These stressors can adversely affect both sleep and mood. These data support screening for suicidal ideation as a priority for transgender students with depression, insomnia or an increase in sleep complaints.

Minority stress theory, sex hormones, and serotonin are potential mechanisms that link sleep disturbances, mental health, and suicide. The minority stress theory states that prejudice and discrimination increase the risk of chronic, psychosocial stressors that can lead to negative health problems in individuals with a minority identity.[44] Transgender individuals often experience negative psychosocial circumstances (i.e. denied access to gender-affirming bathrooms), violence, poor social and familial support, misgendering, delay in gender transition, unstable housing, discrimination, and school or employment difficulties.[22,37,38,45,46] These experiences can increase arousal, vigilance, distress, as well as physiological reactivity, and consequently impair sleep.[36] Minority stress can also adversely impair mental health among transgender individuals.[47] The minority stress that transgender individuals may experience can contribute or result in poor mental and sleep health.

The campus environment may not be supportive of transgender students and can contribute to minority stress.[48] Gender-inclusive or single stall restrooms are rare or nonexistent as is gender-inclusive housing. School documents often will have only male and female categorical options or may not distinguish between sex and gender. Some school-related health care insurances will not cover hormone treatments. Many institutions do not have gender as part of their nondiscrimination policies; although that has been decreasing over the last decade.

Changes in policy and environment may help transgender college students. Encouragingly, community connectedness decreases sleep disturbances.[49,50] Improvement in state-level policies for other minority groups, such as lesbian, gay, and bisexual groups, have led to an improvement in health.[51] In a study among cisgender college students, students with higher rates of sleep satisfaction had significantly lower rates of mental health crises and suicidal ideation.[52] Improving the campus climate for transgender students through policy and both the social and physical environment could potentially help both the mental and sleep health of transgender college students. However, future research is needed.

Serotonin (5-HT) has a role both in suicide and in the regulation of sleep.[39] Poor sleep can also heighten negative emotions such as sadness and hopelessness.[53] Negative mood states are associated with insomnia symptoms and sleep disturbance.[54]

Mechanistically, sex hormone therapy as a gender affirming treatment is a potential cause for sleep disturbances. Transgender men seek therapy with exogenous

Table 7 Associations Between Transgender Identity and Mental Health Measures Among College Students in the US and Canada

	United States		Canada		
	Cisgender	**Transgender**	**Cisgender**	**Transgender**	**P, Interaction**
Mental health diagnosis/treatment					
Depression diagnosis/treatment (ever) Yes	20.72	43.70	14.43	29.40	
OR of depression diagnosis/treatment[1]	Reference	2.95 (2.75, 3.16)	Reference	2.39 (2.02, 2.82)	
P value	<0.0001		<0.0001		0.009
Anxiety diagnosis/treatment (last 12 months) Yes	18.70	37.14	18.16	32.25	
OR of anxiety diagnosis/treatment	Reference	2.53 (2.36, 2.72)	Reference	2.10 (1.79, 2.47)	
P value	<0.0001		<0.0001		0.02
Mental health counseling in current institution Yes	19.18	36.90	20.09	37.66	
OR of mental health counseling in current institution	Reference	2.46 (2.29, 2.65)	Reference	2.32 (1.98, 2.71)	
P value	<0.0001		<0.0001		0.74
Mental health symptoms					
Felt like things were hopeless (last 12 months) Yes	50.35	66.32	59.43	70.27	
OR of felt like things were hopeless	Reference	1.93 (1.80, 2.08)	Reference	1.58 (1.34, 1.85)	
P value	<0.0001		<0.0001		0.03
Feeling overwhelmed Yes	85.99	89.84	89.46	91.85	
OR of feeling overwhelmed	Reference	1.41 (1.26, 1.57)	Reference	1.27 (0.96, 1.67)	
P value	<0.0001		0.0892		0.60
Feeling exhausted Yes	82.70	87.58	88.19	90.72	
OR of feeling exhausted	Reference	1.45 (1.31, 1.61)	Reference	1.26 (0.97, 1.63)	
P value	<0.0001		0.0814		0.36
Feeling lonely Yes	60.71	72.97	66.47	74.19	
OR of feeling lonely	Reference	1.73 (1.60, 1.86)	Reference	1.41 (1.19, 1.67)	
P value	<0.0001		<0.0001		0.03
Feeling sad Yes	66.00	76.26	73.56	82.58	
OR of feeling sad	Reference	1.63 (1.51, 1.77)	Reference	1.64 (1.35, 1.99)	
P value	<0.0001		<0.0001		0.94
Feeling depressed Yes	37.69	57.91	44.15	59.15	

(*Continued*)

Table 7 (Continued).

	United States		Canada		
	Cisgender	**Transgender**	**Cisgender**	**Transgender**	**P, Interaction**
OR of feeling depressed	Reference	2.26 (2.11, 2.42)	Reference	1.80 (1.55, 2.10)	
P value	<0.0001		<0.0001		0.009
Feeling anxious Yes	59.58	74.41	64.27	77.36	
OR of feeling anxious	Reference	1.94 (1.77, 2.10)	Reference	1.84 (1.54, 2.20)	
P value	<0.0001		<0.0001		0.64
Feeling anger Yes	39.80	52.17	47.15	55.45	
OR of feeling angry	Reference	1.63 (1.53, 1.75)	Reference	1.34 (1.18, 1.59)	
P value	<0.0001		<0.0001		0.04
Self-harm Yes	6.72	22.41	8.51	18.57	
OR of committing self-harm	Reference	3.87 (3.56, 4.21)	Reference	2.34 (1.96, 2.89)	
P value	<0.0001		<0.0001		<0.0001
Considered suicide Yes	10.04	28.16	12.76	27.29	
OR of considering suicide	Reference	3.45 (3.19, 3.72)	Reference	2.45 (2.10, 2.95)	
P value	<0.0001		<0.0001		0.0006
Suicide attempted Yes	1.23	5.17	2.00	7.48	
OR of attempting suicide	Reference	4.21 (3.59, 4.94)	Reference	3.92 (2.93, 5.24)	
P value	<0.0001		<0.0001		0.39

testosterone for virilization, while transgender women use anti-androgen therapy with feminizing exogenous estrogens to suppress androgenic effects.[21] Little current literature is available on the impact of SHT on sleep among transgender individuals.[55] Nightly sweating correlated with poor sleep quality among transgender men, but not transgender women, likely through a history of a gonadectomy.[13] Testosterone hormone therapy and decreased estrogen can cause or worsen obstructive sleep apnea, while feminizing sex hormone therapy can improve obstructive sleep apnea.[19,20,35,56] Among cisgender individuals the post-menopausal state is associated with insomnia.[19,57] Theoretically, changes in estrogen and progesterone among transgender men undergoing male affirming sex hormone therapy may be analogous to the hormonal changes experienced by menopausal women. Testosterone administration among testosterone-deficient men (cisgender) is associated with increased insomnia symptoms.[58] Based on this literature, screening for sleep disorders among transgender students starting SHT could be considered.

Prevalence of Mood and Sleep Disturbances by Country

This study found an association between transgender identity and mood disorders among US and Canadian students. However, the magnitude of this association was significantly lower among Canadian students in comparison to their US peers. The attenuated association between

transgender identity and mood among Canadian students may be attributed to the Canadian social and legal climate, both at the national and campus level. Canada has introduced policies in support of sexual and gender protection.[59,60] In 2017 gender identity was added to the Canadian Human Rights Act and the Criminal Code. Canadians can indicate that they do not identify as male or female on their passports. In the US it was in 2020 that the Supreme Court ruled that the 1964 Civil Rights Act provided employment protections for LGBT individuals. At the school level, some protection may be present based on Title VII.[59,61] Data on institutional support of LGBTQ students in the US compared to Canada is minimal, yet suggests that Canadian institutions provide more support. Among 1751 US post-secondary institutions with an undergraduate focus, 8% had a LGBT Resource Centers in contrast to a national sample of 73% and 35% of Canadian universities and colleges, respectively.[36,62,63]

Strengths and Limitations

This study has multiple strengths. First, the examination of sleep and mental health in relation to transgender college students utilized a large, North American sample. Second, the study population is diverse with respect to students' backgrounds and institution types. Third, the availability of student and institutional characteristics allowed their inclusion as confounders in the analyses. Finally, the ACHA-NCHA II survey shows strong reliability over the years of administration.[30] However, the present study has some limitations. First, this sample may not be representative across institutions of higher education, as participation in this survey is greater among ACHA member institutions. The higher participation rates for ACHA member institutions may relate to lower survey costs and increased awareness of the survey itself. Additionally, this population may have an increased white student population; according to the US Census, 54.7% of college students were non-Hispanic white.[64] Nonetheless, this is a large sample of college students from institutions throughout the United States and Canada. Second, the participating students may not represent the entire student population in their respective institutions. Third, while sleep and mood symptoms and diagnoses are self-reported, these self-report questions are commonly utilized to screen for sleep and mood disorders in clinical and research settings.[65,66] This study did not evaluate the use of sex hormone therapy therefore mechanistic implications are theoretical. Finally, this cross-sectional study design does not allow examination of temporal associations between transgender identity, sleep and mental health outcomes, and suicidality.

Conclusion

The burden of sleep and mood disturbances among transgender college students is a substantial public health concern, while the risk of suicidality is a public health crisis. Screening for sleep and mood disorders as well as suicidality is vital for transgender college students. Identification of modifiable risk factors for suicidality, mental health and sleep disturbances in transgender students could inform the design of effective interventions. Adoption of policies that promote diversity, inclusion and equity, in particular gender-affirming policies, may have a positive impact on the sleep, mood and suicidality of transgender college students.

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Abbreviations

ACHA-NCHA II, American College Health Association-National College Health Assessment II; LGBQ, Lesbian, Gay, Bisexual and Queer; ACHA, American College Health Association.

Data Sharing Statement

American College Health Association-National College Health Assessment II link to request data. https://www.acha.org/NCHA/ACHA-NCHA_Data/Research_Projects_and_Data_Access/NCHA/Data/Research_Projects_and_Data_Access.aspx?hkey=e21ae975-78e6-4805-b247-e79564a42a9a.

Portions of the ACHA-NCHA Reference Group data set may be made available for independent analysis. Interested investigators are encouraged to submit proposals. Research is being conducted in the areas of nutrition, weight and eating disorders; BAC and binge drinking; alcohol and marijuana as impediments to academic performance; and depression and suicide ideation. Contact Christine Kukich, at ckukich@acha.org, for further

information regarding access to the NCHA Reference Group data.

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Author Contributions

SH developed the research question, statistical analysis plan, and co-drafted the manuscript. EJ developed the research question and statistical analysis plan, analyzed and interpreted data, and edited the manuscript. LM co-drafted the manuscript. RG co-drafted the manuscript. MH developed the research question and statistical analysis plan, analyzed and interpreted data, and edited the manuscript GLD co-designed the statistical analysis plan, data interpretation, created the tables and co-drafted the manuscript. All authors made substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data; took part in drafting the article or revising it critically for important intellectual content; agreed to submit to the current journal; gave final approval of the version to be published; and agree to be accountable for all aspects of the work.

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